The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

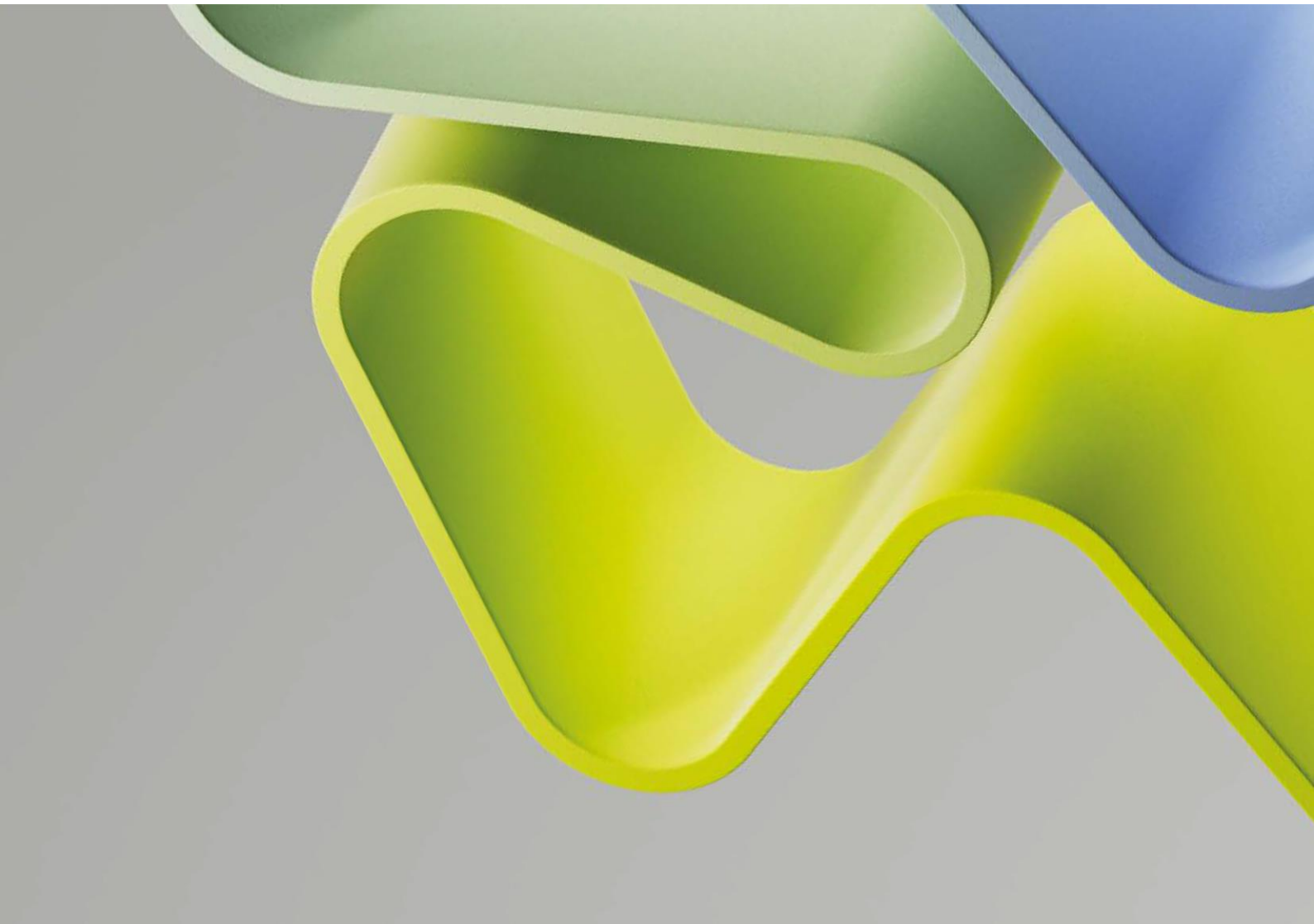
Evaluation Report for Administrative Unit

Administrative Unit: **Department of Process, Energy and Environmental Technology (PEM)**

Institution: **University of South-Eastern Norway (USN)**

Evaluation Committee Higher Education Institutions 4

December 2024



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Statement from Evaluation Committee Higher Education Institutions 4

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions/research institutes within Mathematics, ICT and Technology 2023-2024 and has submitted a report for each administrative unit:

- Department of Building, Energy and Material Technology, UiT the Arctic University of Norway
- Department of Architecture and Technology (IAT), Norwegian University of Science and Technology (NTNU)
- Department of Civil and Environmental Engineering (DCEE), Norwegian University of Science and Technology (NTNU)
- Department of Geoscience (IGV), Norwegian University of Science and Technology (NTNU)
- Department of Structural Engineering (KT), Norwegian University of Science and Technology (NTNU)
- Department of Manufacturing and Civil Engineering (IVB), Norwegian University of Science and Technology (NTNU)
- Department of Energy and Process Engineering (EPT), Norwegian University of Science and Technology (NTNU)
- Department of Built Environment (BE), Oslo Metropolitan University (OsloMet)
- Department of Energy and Petroleum Engineering (IEP), University of Stavanger (UiS)
- Department of Mechanical and Structural Engineering and Material Science (IMBM), University of Stavanger (UiS)
- Department of Process, Energy and Environmental Technology (PEM), University of South-Eastern Norway (USN)

The conclusions and recommendations in this report are based on information from the administrative units (self-assessment), digital meetings with representatives from the administrative units, bibliometric analysis and personnel statistics from the Nordic Institute for Studies of Innovation, Research, and Education (NIFU) and Statistics Norway (SSB), and selected data from the National survey for academic staff in Norwegian higher education and the National student survey (NOKUT). The digital interviews took place in the autumn 2024.

The members of the Evaluation Committee are in collective agreement with the assessments, conclusions and recommendations presented in this report. None of the committee members has declared any conflict of interest.

The Evaluation Committee has consisted of the following members:

Professor Claudio Mazzotti, University of Bologna (Chair)

Professor David Baglee
University of Sunderland

Professor Elsa de Sá Caetano
University of Porto

Professor Sebastian Geiger
TU Delft

Professor Per Heiselberg
Aalborg Universitet

Professor Mohamed Pourkashanian
University of Sheffield

Description of the Administrative Unit

The scientific staff of the Department of Process, Energy and Environmental Technology (PEM) at the University of South-Eastern Norway (USN) includes 10 professors, 17 associate professors, 1 docent, 2 scientists, 11 PhD students, 6 lecturers, and 8,2 engineers, with satisfactory gender balance. While there are only a few female professors, there are several female associate professors which can obtain professor competence.

The research groups are led by group leaders who do not have personnel responsibility for the members. These leaders are responsible for organising group meetings, systematising applications, and reporting. All department staff report directly to the department head. The research groups are loosely organised and operate with minimal direct budgets, relying primarily on external project funding for their research activities. The Head of Department holds overall financial responsibility, allocates project resources, and oversees the hiring of new staff. The research is organised in the following research groups:

- USN's Research Group of Energy and Environmental Technology (URGENT).
- Process Safety, Combustion and Explosions

The department's research goals align with the university's strategy to be regionally anchored and internationally recognised. The department aims to be a visible and preferred regional partner, conducting sustainable and innovative research closely connected to society and working life. Strengthened academic collaborations with European universities and interdisciplinary partnerships have been established, fostering an active campus environment and attracting a diverse student body. The research activities also support several UN sustainability goals. The unit aims to significantly contribute to energy and environmental topics on regional, national, and global levels, addressing climate, energy, and green value creation challenges through research and teaching. The institute emphasises close interaction with regional industry to enhance societal impact, aiming to increase business visits for students, arrange summer jobs in local businesses, develop professional advice schemes, establish university schools, and boost R&D cooperation with regional companies.

The unit aims to enhance national and international collaborations with academic, private, and public partners to stay connected to society and secure funding. As projects grow larger and more collaborative, competition for national research funding intensifies, especially against larger universities. Demonstrating international collaboration boosts chances for EU funding and maintains high academic standards. The department has a long history of collaborating with local industry, particularly at Herøya, Norway's largest land-based industrial area. The university is part of the Powered by Telemark Industry Cluster and has significant CO2 capture projects with Heidelberg Materials in Brevik. Since 2021, the university has had an agreement with Vestfold and Telemark County Municipality to promote higher education and research-based innovation. Collaborations with SINTEF, Herøya Industripark, and the County Municipality include organising monthly lunch seminars for regional industry, fostering new industrial contacts.

Overall Assessment

In the Terms of Reference, the Committee is asked to provide a qualitative assessment of the Department as a whole [ToR,2]. The assessment should consider the current international trends regarding:

- Strategy, resources and organisation.
- Research production, quality and integrity.
- Diversity and equality.
- Relevance to institutional and sectoral purposes.
- Relevance to society.

Strategy, resources and organisation: PEM's overarching research goals are to achieve regional anchoring and international recognition, with a strong ambition to become a preferred regional partner, in alignment with USN strategy. In 2021/22 USN identified strategic research areas for the next six years. Relevant to PEM are the "Energy, Climate, and Environment" area, though the impact on the department's two research groups is not detailed, PEM has the experience to contribute especially to the Energy and Environment fields. Monitoring and assessing the success of the PEM strategy is via informal KPIs based on the number of publications, student numbers, and overall budget performance. Measuring success is challenging due to softer goals. Increased funding could enhance research activities.

Research production, quality and integrity: Research in PEM is organised into two main groups: Process Safety, Combustion and Explosions, and USN's Research Group for Energy and Environmental Technology (URGENT). These groups focus on the priority areas of 1) Hydrogen 2) Process Design and Energy Optimisation 3) Energy Utilisation of Biogas, Biomass, and Waste 4) Environmental concerns. A particular strength is hydrogen technology, though CCS activities are declining due to reduced funding and retirement of key personnel. A weakness is revealed in statistical terms related to the mean normalised citation score, where PEM is below the "Energy Research" average for Norway. Research integrity is handled via a robust set of procedures involving colleagues, HoD, Vice-Rector of Research and ultimately USN's integrity committee.

Diversity and Equality: PEM follows the USN action plan for the 2022-2025 period, with goals to achieve diversity in management positions, gender balance in all academic positions, equal pay, and improve gender balance of students; with measures in place to monitor these and take these into account in recruitment. PEM has better than average female representation at Professor level, and 45% of PhD students are female, significantly higher than the EVALMIT unit average of 29% in 2021. However, PEM is below average at Associate professor level.

Relevance to institutional and sectoral purposes: PEM's activities are aligned with USN's strategy to build competence and knowledge for the green transition, and to foster sustainable economic, social, and cultural innovation. The commercialisation activities are discussed in the context of USN's "Values" and "Strategic Objectives," with support from a central Technology Transfer Office (TTO) that assists in the commercialisation of research. There is a policy in place to report potentially commercial work to the TTO.

Relevance to society: The impact cases presented provide a good overview of the relevance to society of PEM's research. Case 2 is clear and illustrates several strands of relevance,

case 1 gave a general overview of the relevance in the generation of new knowledge in the hydrogen safety area, however it would have benefitted from more detail.

The Terms of Reference for the administrative unit is attached to the report.

Recommendations

1. Encourage stronger links between research staff and regional businesses: Develop or articulate existing methods to foster connections between research staff and local businesses This could involve creating more collaborative projects or partnerships that benefit both the university and the regional economy.
2. Clarify the impact of new USN strategic research areas. Consider how these new areas will affect the department's research groups moving forward, including any changes in focus, funding, or collaboration opportunities.
3. Strategy and KPIs: develop clearer strategies with measurable KPIs to assess success. Regularly update the strategy and ensure it aligns with national priorities.
4. Staff recruitment and succession: improve recruitment strategies and develop formal succession plans to maintain competencies and ensure smooth transitions. Maintain the drive towards gender balance. It is crucial that the recruitment policy incorporates consultations with department staff. This collaborative approach ensures that the perspectives and insights of those who are directly involved in the department's daily operations are considered. By engaging staff in the decision-making process, the policy can better reflect the needs and dynamics of the entire team. This not only fosters a sense of inclusion and transparency but also enhances the overall effectiveness and acceptance of the recruitment decisions. Therefore, the policy should not be solely determined by the Head of Department but rather be a collective effort that values the contributions of all staff members
5. PhD student recruitment: increase efforts to recruit PhD students, and also from diverse regions, particularly Asia, by showcasing the benefits of studying and researching at your institution. Continue to develop and promote industry-linked programs to attract students interested in practical, hands-on experience.
6. Public engagement and impact: enhance public engagement activities and provide detailed, evidence-based impact cases to demonstrate the unit's contributions beyond the university.
7. Regular financial reviews: conduct quarterly financial reviews to ensure that funds are being allocated efficiently and to identify any potential areas for cost savings or reallocation. Develop clear performance metrics for both academic and administrative staff to ensure accountability and to recognise outstanding contributions.
8. Professional development programs: expand career planning and development support by offering more tailored programs, such as leadership training for research group leaders and mentorship programs for early-stage researchers. Organise workshops to help staff improve their grant writing skills, increasing the likelihood of securing additional national and international funding.
9. Strategic planning: engage in long-term strategic planning to align the department's goals with funding opportunities and to anticipate future financial needs. Enhance communication channels within the department to ensure that all staff are aware of available resources, funding opportunities, and support programs. Strengthen partnerships with industry to increase industrial funding.
10. Workload and sabbatical policies: create a formal workload policy to ensure fair and transparent distribution of responsibilities and opportunities among staff. Introduce a

formal sabbatical policy to provide structured opportunities for research leave, enhancing academic growth and innovation.

1. Strategy, Resources, and Organisation of Research

The Department of Process, Energy and Environmental Technology (PEM) at the University of South-Eastern Norway (USN) is home to two research groups: “USN’s Research Group for Energy and Environmental Technology” (URGENT) and “Process Safety, Combustion and Explosions”. The URGENT group, established in 2022 through the merger of the “Energy and Environment” and “Carbon Capture” research groups, is the larger of the two.

The department’s overarching research goals are to achieve regional anchoring and international recognition, with a strong ambition to become a preferred regional partner. These research groups focus on critical areas such as energy and environmental technology, addressing pressing global challenges through innovative research and development.

As of October 2022, the department employed approximately 58 research staff, encompassing PhD students, academic staff, and engineers. This diverse team collaborates to advance the department’s research agenda and contribute to significant scientific outputs. In 2022, PEM achieved 59 author shares, with a three-year average of 57.3 author shares, reflecting the department’s consistent research productivity.

Funding for the department’s research activities is predominantly sourced from external grants and partnerships, underscoring the importance of securing competitive funding to sustain and expand their research efforts. Each research group is led by a dedicated leader who, in addition to their regular academic responsibilities, allocates 20% of their time to leadership duties. This structure ensures focused and effective management of the research groups, fostering an environment conducive to high-impact research.

1.1 Research Strategy

The research strategy aims to achieve both regional and international recognition. Regionally, the goal is to become a preferred partner in specific fields of expertise, though the exact methods to achieve this are not detailed. Efforts to increase business visits and summer jobs for students are mentioned, but these are secondary to fostering research partnerships. The strategy emphasises the importance of visibility and sustainability, aligning with UN sustainability goals. The documents submitted by PEM provide a limited success stories and outlines the partial implementation of strategies for achieving set targets.

The department’s research focuses on energy-related themes, specifically within the “Energy & Environmental Technology” and “Process Safety, Combustion, and Explosions” groups. These activities align with several UN sustainable development goals, although these goals are discussed in general terms. The department aims to be innovative and relevant to society by developing business visits and summer jobs for students, taking professional advice to develop these initiatives, and increasing R&D cooperation.

In 2021 and 2022, USN identified new strategic research areas to be flagship initiatives for the next six years, with the faculty hosting the “Energy, Climate, and Environment” area. This initiative is intended to develop the research environment, but the impact on the department’s two research groups is not detailed. Monitoring and assessing the success of the PEM strategy is via informal KPIs based on the number of publications, student numbers, and overall budget performance. The strategy is updated every 2-4 years, but

measuring success is challenging due to softer goals. Increased funding could enhance research activities.

The department adapts to changes in government policy, such as the shift in CO_2 capture funding and the long-standing focus on hydrogen safety. For example, CO_2 capture was not part of the strategy 15 years ago but became a national strategy, leading to increased funding. However, CO_2 capture funding has since decreased. The department has a 30-year history in hydrogen safety research, which has allowed them to build upon this area.

The research flagships and PEM's strengths include a focus on energy, climate, and environment, with specific expertise in CO2 transport by liquid and regional projects in carbon capture relevant to the cement industry. PEM believes that their work in climate and environment as a flagship has secured some funding, making it an important part of their research portfolio. PEM submitted documents did not provide detailed examples of research outputs. Instead of focusing solely on high-level goals, offer specific examples of the actual outputs and achievements of the research groups. This could include case studies, success stories, or detailed reports on significant research findings and their impacts.

Recommendations for the administrative unit

General recommendations include encouraging stronger links between research staff and regional businesses, providing detailed examples of research outputs, and clarifying the impact of new research areas on the department's groups. This could involve articulating existing methods more clearly or developing new ways to foster these connections. Additionally, more detailed descriptions of the actual outputs of the research groups, rather than just high-level goals, would be beneficial.

The specific recommendations to the administrative unit are as follows:

- Encourage stronger links between research staff and regional businesses: Develop or articulate existing methods to foster connections between research staff and local businesses beyond the current goals of increasing student interactions. This could involve creating more collaborative projects or partnerships that benefit both the university and the regional economy.
- Clarify the impact of new research areas: provide more information on the outcomes of the recent activity to identify new strategic research areas. Explain how these new areas will affect the department's research groups moving forward, including any changes in focus, funding, or collaboration opportunities.
- Strategy and KPIs: develop clearer strategies with measurable KPIs to assess success. Regularly update the strategy and ensure it aligns with national priorities.
- Risk mitigation: establish formal risk mitigation strategies, especially for retaining key competencies and managing staff in emerging fields.
- Recruitment and succession: improve recruitment strategies and develop formal succession plans to maintain competencies and ensure smooth transitions.
- Public engagement and impact: enhance public engagement activities and provide detailed, evidence-based impact cases to demonstrate the unit's contributions beyond the university.

These recommendations aim to enhance the visibility and effectiveness of the department's research efforts, ensuring they are both impactful and well-integrated with regional and international goals.

1.2 Organisation of Research

The strategic review carried out by USN in 2021/22 highlighted several key points. Two research groups cover different aspects of energy-related research: Process Safety, which has been active for 20 years with about 10 members, and Energy & Environmental Technology, a larger group established in 2022. The heads of these research groups are allocated 20% of their time to this role. These research areas align well with USN and departmental strategies, focusing on sustainability, innovation, and close proximity to society and working life.

USN offers two PhD programs: Process, Energy & Automation Technology since 2009, and a new program in Technology starting in 2023. There are some informal links with Master's students. Bachelor programs in Mechanical Engineering and Chemical Engineering (Clean Energy and Process) are connected to Master's programs in Process Technology and Energy & Environmental Technology. Lecturing is provided by researchers and some industry guest lecturers, including adjunct professors from industry, though the impact of these adjunct professors needs assessment.

The integration of Bachelor's and Master's research projects with research groups and industry is good, indicating a suitable organisation of research overall.

However, the operational strategy lacks a risk mitigation strategy, particularly concerning the loss of key competencies. PEM should have a formal method to retain competence but currently lacks a formal evaluation process. If PEM hires additional staff in emerging fields without secured funding, these staff members may be laid off. Most staff are generalists and can be utilised in other fields. A clear recruitment strategy, including a succession plan for retiring researchers, is required. PEM has an informal plan but needs to improve to maintain competencies. Improving gender balance should be a stated goal in announcements.

<u>Recommendations</u> to the administrative unit

- The current organisation of research is reasonable, with no fundamental changes necessary. However, it would be beneficial to know more about the outcomes of appointing industrial adjunct professors.
- The operational strategy has several areas that need attention. Firstly, it lacks a risk mitigation strategy, particularly for retaining key competencies. Additionally, there is no formal evaluation method for maintaining competence within PEM. The recruitment strategy is currently informal and requires improvement, especially in terms of succession planning. Lastly, the goal of improving gender balance should be emphasised in announcements.
- The current organisation of research is generally suitable, but there are areas that require attention to ensure long-term sustainability and effectiveness such as:
- Evaluate the potential synergy between two research groups by analysing their strengths and areas of expertise. Foster collaboration through joint research proposals, ensuring that both groups contribute their unique perspectives and skills. Engage PhD students in formal approaches to research, providing them with opportunities to participate in these collaborative projects. Additionally, initiate interdisciplinary research, leveraging the diverse knowledge and methodologies of the involved groups.
- Risk mitigation Strategy: develop a formal risk mitigation strategy to retain key competencies. This should include a structured evaluation method to assess and maintain the necessary skills within PEM.

- Recruitment and succession planning: Implement a clear and formal recruitment strategy, including a succession plan for retiring researchers. This will help maintain the continuity and quality of research.
- Gender balance: actively promote gender balance in recruitment announcements and ensure that this goal is integrated into the institution's broader strategy.
- Assessment of adjunct professors: conduct an assessment of the impact of industrial adjunct professors to understand their contributions and identify areas for improvement.
- By addressing these areas, the administrative unit can enhance the effectiveness and sustainability of its research programs.

1.3 Research Funding

The department receives a total of approximately 17.73 million NOK per year annually. This funding comes from various sources, including national grants amounting to 8.4 million NOK per year, international funding of 1.7 million NOK per year, and industrial funding of 625,000 NOK per year. Additionally, internal funding constitutes about 10% of the department's budget, which is 4 million NOK per year, plus an extra 3 million NOK from contributions and commissions in the PEM budget. The annual funding received by PEM is considered slightly below average. Generally, this level of funding for research-intensive departments is regarded as below average at the national level.

This financial support is allocated to 28 academic staff members at the Associate Professor level and above. Furthermore, 20% of the time allocation is dedicated to the two Research Group leaders.

Career planning and development support is provided through the USN Stipendiary and Post-Doctoral organisation for early-stage researchers, the Erasmus-funded "European Digital University (EDUC)" program for early career researcher development, and seed funding from newly established strategic research areas (SRA). The support provided is deemed adequate, meeting the necessary requirements and expectations.

Recommendations to the administrative unit

Here are a few recommendations to further enhance the administrative and financial management of your unit:

- Regular financial reviews: conduct quarterly financial reviews to ensure that funds are being allocated efficiently and to identify any potential areas for cost savings or reallocation. Develop clear performance metrics for both academic and administrative staff to ensure accountability and to recognise outstanding contributions.
- Professional development programs: expand career planning and development support by offering more tailored programs, such as leadership training for research group leaders and mentorship programs for early-stage researchers. Organise workshops to help staff improve their grant writing skills, increasing the likelihood of securing additional national and international funding.
- Strategic planning: engage in long-term strategic planning to align the department's goals with funding opportunities and to anticipate future financial needs. Enhance communication channels within the department to ensure that all staff are aware of available resources, funding opportunities, and support programs. Strengthen partnerships with industry to increase industrial funding.
- Implementing these strategies can help optimise the use of PEM department's resources and support the professional growth of PEM staff.

1.4 Research Infrastructures

In the administrative unit self-assessment, no specific data was presented. However, there was a comment indicating that PEM is involved in the “Katapult (Node) project in Telemark” and mentions of industrial collaboration. The research group report concerning URGENT does not provide specific details but notes participation in numerous research projects and roles as project leaders and partners.

Regarding the FAIR principles, uploaded data sets are curated by “USN data stewards,” and the principles are applied in terms of publication and data adjustment. The research data support service at USN participates in meetings, workshops, and courses where the FAIR principles are taught. Additionally, it provides information on being a FAIR data handler.

Recommendations to administrative unit

Improving the infrastructure of PEM (Process, Energy, and Materials) can significantly enhance its efficiency and effectiveness. Here are some recommendations:

- Invest in state-of-the-art machinery and tools to improve precision and efficiency,
- Develop a robust data management system to ensure accurate and real-time data collection and
- Implement stringent quality control measures to maintain high standards.

1.5 National and international collaboration

The administrative unit acknowledges the significant value of both national and international collaborations. Although it does not have a formal policy dedicated to these collaborations, it aligns with the overarching strategy of USN, which emphasises the importance of such partnerships. Historically, the unit has engaged in local industrial collaborations, recognising their importance in securing funding for projects that are industrially based. These collaborations not only enhance the unit’s ability to apply for and receive funding but also contribute to the practical application and impact of their projects. Furthermore, the unit has detailed a wide range of national and international collaborations, showcasing its commitment to fostering strong, productive partnerships across various sectors and regions. These collaborations are instrumental in driving innovation, sharing knowledge, and achieving common goals.

1.6 Research staff

At the lecturer level and above, approximately 20% are female. For EVALMIT units overall, this figure is 25%. There is better than average female representation at the Professor level, but below average at the Associate Professor level. There are 11 PhD holders (27.5%), which is significantly lower than the EVALMIT unit average of 43% in 2021, although 45% of these are female, higher than the EVAALMIT unit average of 29%. At the Professor level, 25% of researchers are female (compared to 20% overall in the EVALMIT unit). At the Associate Professor level, 42.5% of researchers are female (compared to 21% overall in the EVALMIT unit). At the post-doctoral level, 5% are female (compared to 16% overall in the EVALMIT unit). There is no data available on age distribution or succession plans.

The strategy to increase the number of PhD students is challenging. Many potential students come from Asia. Collaboration with industry attracts students, and PEM recently started an “Industry Masters Programme” where students work 50% at a company and 50% at the University.

The recruitment policy is only mentioned in the goal to upgrade most vacant positions to at least Associate Professor status.

There is no formal workload policy for staff. It is possible to have a sabbatical if it is financed, and there are other schemes for short-term stays abroad. There is no formal sabbatical policy, but research leave is possible for shorter periods depending on the work plan. The Head of Department devises the work plan in spring for the following year, combining the merits of the previous three years with the workload in funded research. Typically, the research time distribution for Associate Professors and Professors ranges from 15% to 60%.

Staff and Early Career Researchers (ECRs) are encouraged to spend time at other institutions. Funding sources include Erasmus funding from USN's budget, national/bilateral funding sources, USN mobility scholarships, European Digital University (EDUC), and Young European University network (YERUN) opportunities. A mobility coordinator within the personnel department assists with practicalities. Early Career Researchers (ECRs) are trained on core capabilities such as proposal writing and networking through formal support programmes at the university level. The Postdoc association works on research training, career guidance, mobility, and proposal writing. USN has a programme for women professorial candidates and a supervisor programme to train future supervisors.

Recommendations to the administrative unit

- Increase female representation: at Associate Professor Level Implement targeted recruitment and retention strategies to improve female representation at the Associate Professor level, where it is currently below average.
- Recruitment policy: develop a comprehensive recruitment policy that includes clear goals and strategies for upgrading vacant positions and improving diversity. Establish a system to collect and analyse data on age distribution and succession planning to better understand and address potential gaps
- Workload and sabbatical policies: create a formal workload policy to ensure fair and transparent distribution of responsibilities among staff. Introduce a formal sabbatical policy to provide structured opportunities for research leave, enhancing academic growth and innovation.
- Expand mobility opportunities: increase awareness and accessibility of mobility opportunities, ensuring staff and ECRs are well-supported in their endeavours to collaborate with other institutions.
- PhD student recruitment: increase efforts to recruit PhD students, also from diverse regions, particularly Asia, by showcasing the benefits of studying and researching at your institution. Continue to develop and promote industry-linked programs to attract students interested in practical, hands-on experience.

1.7 Open Science

The University of South Norway (USN) adheres to its policies, ensuring that research data is managed according to FAIR principles. The university owns the research data, but for projects with external partners, ownership is specified in the cooperation agreement. All academic articles are available from the institutional repository.

In 2022, USN developed a new institutional policy. The university also has a publishing fund that covers open access for journals not included in national agreements. Their publication strategy aims to increase open science, although only about 50% of publications have been open access since 2017. This percentage has not changed significantly over the years, with 54.2% of publications not being open access in 2022.

The PEM team doubts the accuracy of the numbers in their report, suggesting that some articles might not have been counted. They recommend discussing individual publication strategies with researchers. While open science options were limited a decade ago, the situation has improved significantly today.

Recommendations on how to promote open science

- Conduct workshops and training sessions for researchers to emphasise the importance of open access and familiarise them with the available resources and funding options.
- Establish a dedicated support team to assist researchers with the open access publication process, including navigating funding applications and understanding copyright issues. Implement a robust monitoring system to track the percentage of open access publications. Regularly review and analyse this data to identify trends and areas for improvement.
- Hold regular meetings with researchers to discuss their publication strategies and address any concerns or challenges they face in publishing open access. Promote an open science culture that values and rewards open science practices. This could include recognising and celebrating researchers who publish open access. Periodically review the institutional policies to ensure they are aligned with the latest developments in open science and open access publishing.

2. Research production, quality and integrity

Research in PEM is organised into two main groups: Process Safety, Combustion and Explosions, and USN's Research Group for Energy and Environmental Technology (URGENT). These groups focus on several priority areas:

- Hydrogen: This includes research on hydrogen safety and explosions, which is crucial for the development of safe hydrogen technologies.
- Process Design and Energy Optimisation: This area covers the design and optimisation of processes, particularly in the context of carbon capture, storage, and utilisation (CCS). The aim is to make these processes more efficient and sustainable.
- Energy Utilisation of Biogas, Biomass, and Waste: Research here focuses on how to effectively use biogas, biomass, and waste as energy sources, contributing to renewable energy solutions.
- Environmental Concerns: This includes managing effluents to air and water, and developing methods to clean effluents from various industries, transport, and agriculture to reduce environmental impact.

The department prides itself on its strength in hydrogen technology. Despite the unfortunate passing of the biogas research subgroup leader in 2020, the department has continued to produce significant research outputs in this area. However, activities in CCS are declining due to reduced funding and the retirement of key personnel.

Research integrity is a critical aspect of the department's operations, based on the standards set by USN. If there are suspicions of misconduct, these can be reported to colleagues or the Head of Department (HoD). The HoD and research group leaders are responsible for fostering a climate of responsible research ethics. Allegations of misconduct are reported to the Vice-Rector of Research or USN's integrity committee, ensuring a robust structure for maintaining research integrity.

In 2022, the department had 49.9 author shares, with a three-year average of 47.7. The top 10% citation share was 2.5%, and the mean normalised citation score (MNCS) was 55. This indicates that, in relative terms, the MNCS is lower than the “Energy Research” average of 116 for Norway, suggesting there is room for improvement in the impact of their research publications.

URGENT have a broad core of research activities, and a big project portfolio. But, comprised mainly of projects with a rather low funding share. URGENT funding is mostly from RCN with only a little from Industry, or other national or international sources.

There is a high publication rate in international journals, but generally at relatively low impact factor journals, and reflected in the relatively low citation statistics.

The information providing was lacking in the fact that in several instances claims were stated but not backed up by sufficient documentation (details of international collaboration with project partners, details of contributions to research-based education, data-based documentation of societal impact).

Greater effort needs to be put into increasing the level of funding in future years, more details should also be provided concerning funding and employees.

2.1 Research quality and integrity

Research group USN Research Group of Energy and Environmental Technology (URGENT) overall assessment

URGENT have broad core research activities. Concerning the scientific quality, the group has a big project portfolio but comprised mainly of projects with a rather low funding share. URGENT has – based on its self-assessment report - a very low funding/personnel balance. URGENT funding comes mainly from RCN. Only very little from industry, other Norwegian sources and very limited international funding (almost non-existing). A high (but definitely not exceptional) publication rate in international journals is documented, but the impact factor of the journals applied seems to be rather low, as does the citation numbers. Most publications are by local authors, others are with contribution from SINTEF and Chalmers (which is not exactly signalising international cooperation). The societal contribution is very weakly documented.

3. Diversity and equality

Diversity and Equality follows the USN action plan for Equality, Diversity and Inclusion, 2022-2025. This has goals to achieve diversity in management positions, gender balance in all academic positions, equal pay, and improve gender balance of students; with measures in place to monitor these and take these into account in recruitment. Procedures are also in place concerning the expertise in Diversity and Diversity management, provisions for building design/improvements in the context of disability, due regard of disability in the context of teaching materials. Policies are set out regarding sexual harassment and discrimination. In strategic terms, the equality and inclusion perspective will be integrated in all planning work at USN.

In terms of the unit’s current status:

- At lecturer and above, approximately 20% female
- Better than average female representation at Professor level (compare to national level)

- Below average at Associate Professor level (compare to national level)
- 45% of PhD students female. significantly higher than EVALMIT unit average of 29% in 2021 which is very good at national level compared to 21% overall in the EVALMIT unit)
- At the post-doctoral level, 5% are female (compared to 16% overall in the EVALMIT unit)
- There is no data available on age distribution or succession plans.

It is recommended to Increase female representation at Associate Professor Level: Implement targeted recruitment and retention strategies to improve female representation at the Associate Professor level, where it is currently below average.

4. Relevance to institutional and sectorial purposes

The department's activities are aligned with USN's strategy to build competence and knowledge for the green transition, and to foster sustainable economic, social, and cultural innovation. The commercialisation activities are discussed in the context of USN's "Values" and "Strategic Objectives," with support from a central Technology Transfer Office (TTO) that assists in the commercialisation of research. There is a policy in place to report potentially commercial work to the TTO.

USN's IPR policy is designed to facilitate the dissemination and exploitation of university work. Inventors are entitled to receive one-third of all income USN receives from the invention and are free to form their own spin-off company with a suitable license agreement with USN if necessary. Assistance in preparing applications for innovation and commercialisation projects is available from USN, covering areas such as innovation management, data treatment, budgeting, archiving, project kick-off meetings, contracts, and patent applications.

Overall, there is a suitable range of policy and support mechanisms in place. Five commercial/innovation projects are listed, with three of them having links. However, more details would have been useful to provide context for these projects.

Regarding training, mentoring, and career opportunities, the master's programs align with the department's research groups, and research staff teach in these programs. Master's projects are usually themed around research groups and often have an industrial co-supervisor. The department has formal and informal educational links to SINTEF and NNTU, with an example being the teaching of Carbon Capture at NNTU to department master's and PhD students. Overall, the training and mentoring opportunities are satisfactory, with the added benefit of most master's projects having an industrial co-supervisor.

5. Relevance to society

The impact cases presented provide a reasonable overview of the relevance to society of PEM's research. Case 1 gives a general overview of the relevance in the generation of new knowledge in the hydrogen safety area; however it would have benefitted from more detail. Case 2 is clearer and illustrates several strands of relevance, from the advancement of fundamental knowledge in the chemistry and performance of amine solvents, along with work on cost estimations. In addition, it illustrates the work involved in the actual implementation of a CCS unit in Cement production from evaluation of various alternatives in the initiation phase, then in technology development, early phase design work, ultimately

leading to influencing the final design from the technology supplier, and finally the planned work in the evaluation phase once the plant is operational.

5.1 Impact cases

Comments to impact case 1: Hydrogen Safety

Work of the research group “Process Safety, Combustion and Explosions” related to Industrial safety and applied research on new energy carriers and fuels. Three research projects specifically mentioned: “HyLOCD” related to maritime fuel cells, “Green Platform” related to seabed hydrogen storage, and again “Green Platform” related to production of hydrogen from ammonia. Then 13 specific projects (including these 3) are stated, with 12 specific national partners and 4 international partners. “Details of the Impact” refer to 4 projects with a one sentence summary of each, interestingly of the three specific research projects mentioned previously, only “HyLOCD” is mentioned here.

The summary of impact statement illustrates the general details in terms of the generation of new knowledge, the collaboration with partners, and the consequent advance in technological development. However the detail could be clearer, the Details of impact statement consists just of one sentence on each of four projects which make it difficult to fully appreciate the importance and strengths of these cases.

Comments to impact case 2: CO_2 capture realisations

Work of the research group of “Energy and CO_2 capture” (Now part of the URGENT research group) related to design of CO_2 capture processes and utilisation. The most important being contribution to the realisation of the full-scale CO_2 capture plant in Brevik, the TCM test centre at Mongstad, and in cost estimation and optimisation methods for future CO_2 capture projects. Underpinning research related to amine-based solvents (degradation, solvent physical properties), test rigs and alternative CO_2 absorption agents performance, utilisation in chemicals production, electrification of cement calciners + CO_2 capture, process simulation, cost estimations/optimisations, links to Bachelors/Masters/PhD research. From these research areas, that highlighted is that connected to development of the CO2 capture plant at Heidelberg Materials, Brevik. Two projects are then described, “CO_2stCap” related to cost efficient capture in four Nordic industries, and “Align-CCUS” focused on Greenland and the development of a central hub to capture emissions from all emission sources.

Details of Impact relates to the Heidelberg cement plant (earlier Norcem) and the resulting full-scale CO_2 capture plant built in Brevic. Further details are then provided related to TCM Mongstad (process simulation models, and amine degradation tests), and finally, a brief summary of projects funded by CLIMIT together with SINTEF related to CO_2 capture.

The case of the full-scale capture plant at Brevic is described in sufficient detail to provide an insight into the research group’s contribution to this project. This impact case is highly relevant and important, relating to the “World’s first” CO_2 capture facility in the cement industry, as such it meets the impact criteria in terms of a tangible effect to the economy, society and environment beyond academia. The research groups contribution is significant, involving evaluation of various alternatives in the initiation phase, then in technology development, early phase design work, ultimately leading to influencing the final design from the technology supplier, and finally the planned work in the evaluation phase once the plant is operational. The impact details related to TCM Mongstad and the projects funded by CLIMIT with SINTEF illustrate the advancement of fundamental research knowledge in the context of amine solvent chemistry, performance and costs; all important topics in the future implementation of CCS.

Methods and limitations

Methods

The evaluation is based on documentary evidence and online interviews with the representatives of Administrative Unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol that guided the process
- Terms of Reference
- Administrative Unit's self-assessment report
- Administrative Unit's impact cases
- Administrative Unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys (only for HEI's)

After the documentary review, the Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the Administrative Unit. The Committee shared the interview questions with the Administrative Unit three weeks before the interview.

Following the documentary review, the Committee interviewed the Administrative Unit in an hour-long virtual meeting to fact-check the Committee's understanding and refine perceptions. The Administrative Unit presented answers to the Committee's questions and addressed other follow-up questions.

After the online interview, the Committee attended the final meeting to review the initial assessment in light of the interview and make any final adjustments.

A one-page summary of the Administrative Unit was developed based on the information from the self-assessment, the research group assessment, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary without adjustments.

Limitations

The Committee judged that the Administrative Unit's self-assessment report was insufficient to assess all evaluation criteria fully, and some information gaps remained after the interview with the Administrative Unit.

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
University of South-Eastern Norway (USN)	Department of Process, Energy and Environmental Technology (PEM)	USN Research Group of Energy and Environmental Technology (URGENT)

Terms of Reference (ToR) for the administrative unit

The board of Faculty of Technology, Natural Sciences and Maritime Sciences mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess the Department of Process, Energy and Environmental Technology based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by the Department of Process, Energy and Environmental Technologyas well as its relevance to institutional and sectoral purposes, and to society at large. You should do so by judging the unit's performance based on the following five assessment criteria (a. to e.). Be sure to take current international trends and developments in science and society into account in your analysis.

a) Strategy, resources and organisation

b) Research production, quality and integrity

c) Diversity and equality

d) Relevance to institutional and sectoral purposes

e) Relevance to society

For a description of these criteria, see Chapter 2 of the mathematics, ICT and technology evaluation protocol. Please provide a written assessment for each of the five criteria. Please also provide recommendations for improvement.

In addition, we would like your report to provide a qualitative assessment the Department of Process, Energy and Environmental Technology as a whole in relation to its strategic targets. The committee assesses the strategy that the administrative unit intends to pursue in the years ahead and the extent to which it will be capable of meeting its targets for research and society during this period based on available resources and competence. The committee is also invited to make recommendations concerning these two subjects. 2

Documentation

The necessary documentation will be made available by the mathematics, ICT and technology secretariat at Technopolis Group.

The documents will include the following:

- a report on research personnel and publications within mathematics, ICT and technology commissioned by RCN
- a self-assessment based on a template provided by the mathematics, ICT and technology secretariat

Interviews with representatives from the evaluated units

Interviews with the the Department of Process, Energy and Environmental Technology will be organised by the evaluation secretariat. Such interviews can be organised as a site visit, in another specified location in Norway or as a video conference.

Statement on impartiality and confidence

The assessment should be carried out in accordance with the *Regulations on Impartiality and Confidence in the Research Council of Norway*. A statement on the impartiality of the committee members has been recorded by the RCN as a part of the appointment process. The impartiality and confidence of committee and panel members should be confirmed when evaluation data from the Department of Process, Energy and Environmental Technology are made available to the committee and the panels, and before any assessments are made based on these data. The RCN should be notified if questions concerning impartiality and confidence are raised by committee members during the evaluation process.

Assessment report

We ask you to report your findings in an assessment report drawn up in accordance with a format specified by the mathematics, ICT and technology secretariat. The committee may suggest adjustments to this format at its first meeting. A draft report should be sent to the Department of Process, Energy and Environmental Technology. The Department of Process, Energy and Environmental Technology should be allowed to check the report for factual inaccuracies; if such inaccuracies are found, they should be reported to the mathematics, ICT and technology secretariat within the deadline given by the secretariat. After the committee has made the amendments judged necessary, a corrected version of the assessment report should be sent to the board of Faculty of Technology, Natural Sciences and Maritime Sciences and the RCN no later than two weeks after all feedback on inaccuracies has been received from the Department of Process, Energy and Environmental Technology

Appendices

1. Description of the evaluation of EVALMIT
2. Invitation letter to the administrative unit including address list
3. Evaluation protocol
4. Template of self-assessment for administrative unit (short-version)

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